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ABSTRACT

This study explored the cultural influences on children's self-reported environmental actions, perceptions, and understandings; investigated the relationships among the behavioral, affective, cognitive, and demographic variables; and developed models of children's responsible environmental behavior (Huang, 2001). The cross-cultural comparison utilized a survey of Canadian and Taiwanese grade 5 children. English and Mandarin questionnaires developed with reasonable validity and reliability were used to collect data regarding children's environmental behaviors, attitudes, concerns, emotional dispositions, knowledge, and situational factors causing children's irresponsible behavior. Useable data collected from 278 grade 5 children from Victoria, Canada, and 483 grade 5 children from Kaohsiung, Taiwan, were analyzed using descriptive statistics, t-tests, correlations, and multiple regression analyses. The results revealed more similarities than differences between these Canadian and Taiwanese children. Television was the most popular source of environmental information for both groups of children. Canadian children had much more variety and frequency of participating in nature activities than Taiwanese children. Children from both countries expressed positive environmental behavior, positive attitudes toward the environment, high concern about the environmental problems, high emotional disposition toward current environmental situations, and moderate environmental knowledge. Gender and nature experience were the two influential demographic variables on children's environmental scores. The main reasons reported by these children for irresponsible behavior toward the environment were inconvenience and forgetfulness. The original model of children's responsible environmental behavior did not fully reflect these Canadian and Taiwanese data; therefore, alternative models were developed. Affective variables are stronger influences on children's responsible environmental behavior than the cognitive variable for children in both countries. (Contains 128 references.) (Author/JDM)

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A Comparative Study of Canadian and Taiwanese Grade 5 Children's Environmental Behaviors, Attitudes, Concerns, Emotional Dispositions, and Knowledge

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Abstract

This study explored the cultural influences on children's self-reported environmental actions, perceptions, and understandings; investigated the relationships among the behavioral, affective, cognitive, and demographic variables; and developed models of children's responsible environmental behavior (Huang, 2001). The cross-cultural comparison utilized a survey of Canadian and Taiwanese grade 5 children. English and Mandarin questionnaires developed with reasonable validity and reliability were used to collect data regarding children's environmental behaviors, attitudes, concerns, emotional dispositions, knowledge, and situational factors causing children's irresponsible behavior. Useable data collected from 278 grade 5 children from Victoria, Canada, and 483 grade 5 children from Kaohsiung, Taiwan, were analyzed using descriptive statistics, t-tests, correlations, and multiple regression analyses.

The results revealed more similarities than differences between these Canadian and Taiwanese children. Television was the most popular source of environmental information for both groups of children. Canadian children had much more variety and frequency of participating in nature activities than Taiwanese children. Children from both countries expressed positive environmental behavior, positive attitudes toward the environment, high concern about the environmental problems, high emotional disposition toward current environmental situations, and moderate environmental knowledge. Gender and nature experience were the two influential demographic variables on children's environmental scores. The main reasons reported by these children for irresponsible behavior toward the environment were inconvenience and forgetfulness. The original model of children's responsible environmental behavior did not fully reflect these Canadian and Taiwanese data; therefore, alternative models were developed. Affective variables are stronger influences on children's responsible environmental behavior than the cognitive variable for children in both countries.

A Comparative Study of Canadian and Taiwanese Grade 5 Children's Environmental Behaviors, Attitudes, Concerns, Emotional Dispositions and Knowledge

Introduction

The ultimate goal of environmental education is to develop individuals who will act positively by demonstrating responsible behavior toward their environment in order to develop a sustainable environment (Childress & Wert, 1976; Elliott, 1999; Hungerford et al., 1980). Responsible environmental behavior involves individuals' actions to protect and improve the environment in which a variety of approaches were recognized and available for individuals to apply (Hsu & Roth, 1998). Environmental sustainability requires that people are able to utilize the resources to improve their living quality without sacrificing the Earth's capacity to sustain all life (British Columbia Roundtable on the Environment and the Economy, 1993; Scott & Oulton, 1998). This harmonious relationship is built upon the equilibrium and reciprocal interactions within the environment and recognizes the limitations of the resources and space, the interdependence of all living things, and the necessity to align traditional human values with the needs of other living things (Bonnett, 1999; Bowers, 1996; Colwell, 1997; Corcoran & Sievers, 1994; Littledyke, 1996; Orr, 1990; Peterson, 1999; Reilly, 1991).

Environmental education recognises that the long-term solution is to promote positive values, to improve people's attitudes, awareness, knowledge, and behavior, and to nurture responsible citizenship and environmental literacy. However, a number of studies have not supported the assumed relationships among values, attitudes, awareness, knowledge, and behavior (Ritchie et al., 1981; Verhallen & Van Raaij, 1981; Webster, 1975). This study examined the foundation of environmental education by investigating the extent to which attitudes, knowledge, awareness, and behaviors are related for children from two distinctly different countries — Canada and Taiwan. Children will be the future decision makers and problem solvers for the environment (Bradley et al., 1999; Gambro & Switzky, 1996; Reid & Sa'di, 1997); however, the importance of understanding children's perspectives has been ignored in much environmental education research (Cohen & Wingerd, 1993; Paraskevopoulos et al., 1998). Environmental issues need to be viewed from a global and a cross-cultural perspective. Understanding the differences in various

social, cultural, political, and economic situations will broaden the worldview of sociocultural contexts; and understanding these universals could provide foundations for global environmental co-operation.

Background

Children's environmental concerns and views are influenced by the individual's cognitive status, exposure to nature, and socialization (Dillon & Gayford, 1997; Easterling et al., 1995). Whereas formal education was an important factor for developing children's environmental concepts, informal education involving popular media, parents, peers, and nature activities played an important or sometimes more important role in nurturing children's environmental views (Boyes & Stanisstreet, 1997; Eagles & Demare, 1999; Glazar & Vrtacnik, 1998; Hillcoat & Forge, 1995; Palmer & Suggate, 1996).

Children hold somewhat accurate but intuitive perceptions and conceptions about the environment. Elementary school children (11- to 13-year-olds) in the United Kingdom expressed positive attitudes toward nature and the environment (Bonnett & Williams, 1998). These children indicated that nature was a place that was not influenced by people's activities, a wild place where not only people lived but also where other creatures lived, and a surrounding where people can seek relief and freedom. They believed that people and nature were interdependent of each other. These children expressed a strong empathy toward animals and plants and that animals deserved the same consideration as people. The children had a biocentric perspective infused with a strong moral component regarding their relationship with other creatures and the environment. They identified several problematic issues including pollution, cutting down trees, deforestation of rainforests, species extinction, and recycling without distinguishing between local or global issues. They believed that environmental issues were pervasive, and their understanding of the issues seemed emotionally charged. Most of these children attributed the responsibility for the environment to individuals rather than to others or to the government. Hillcoat and Forge (1995) found that adolescents (15- to 17-year-olds) in Australia recognized the environment as a living system, believed the elements within this system existed interdependently, but perceived human beings and environment as dichotomous terms. They trusted the environmental information developed from their own experience or provided by parents and relatives more than

information from the media. These adolescents believed that the media overemphasized certain environmental issues and were overly commercialized. They blamed people's laziness, business, and the government's lack of environmental awareness as causes of the environmental degradation. Generally, the participants in this study articulated global and local environment problems with different levels of concern. Most of the adolescents in inner city schools considered global problems to be more serious than local problems. The adolescents in suburban schools had contrary views and were more concerned about local problems. Most of the young people in this study thought that an individual's effort cannot make a positive contribution toward improvement of the environment, had a rather negative view toward the environment, and felt disempowered due to the lack of problem-solving skills. They believed that only the government and powerful others could improve the environment.

Comparative studies of children from different countries indicated that cultural, social, political, and economic factors may influence their perceptions and conceptions about the environment. Barraza (1999) explored Mexican and English primary children's (7- to 9-year-olds) environmental awareness by analyzing their drawings about the environment. The analysis of the drawings suggested that most children had a deep concern about environmental problems that affect their life. Fifty-four percent of children had negative views when asked about the future of the earth in 50 years, while only 22% were optimistic for the near future. The children from schools with an environmental education policy did not have higher concerns and they were more pessimistic about the environment than children from schools without an environmental education policy. Barraza suggested that while children from these two countries expressed more similarities than differences, the rather poor socioeconomic situation in one Mexican school negatively influenced children's perceptions. Reid and Sa'di (1997) compared environmental attitudes of Jordanian and British primary school children and found that generally British children had higher scores in environmental attitudes than Jordanian children. The likely influences for this difference were the media and the different structure of environmental education programs in the two countries. Programs on television and radio, and articles in newspapers were more environmentally oriented in Britain than in Jordan. Although environmental education was integrated in the

mainstream curriculum and the objectives were not precisely focused in both countries, environmental education programs in Britain had a more explicit structural framework than in Jordan. A study of adolescents' (12-year-olds) environmental views in Germany and Russia indicated that adolescents in both countries had highly emotional dispositions toward environmental problems (Szagun & Pavlov, 1995). They were anxious, angry, and sad about environmental destruction and rejected an attitude of indifference towards environment problems. Russian adolescents were anxious but were rather unwilling to engage in environmental activities, while German adolescents with the same level of anxiety were more willing to engage in environmental activities. German young people felt able to do something about improving their environment. This difference appeared to be due to the low priority assigned to environmental issues in Russia that led to people's lack of knowledge of environmental protective behavior.

In general, individuals' awareness, views, and behavior toward the environment were influenced by political ideology, economical settings, and social structures within certain cultures (Bechtel et al., 1999; Dillon et al., 1999; Kahn Jr. & Friedman, 1998; Kaiser & Wilson, 2000; Lee et al., 1997; Robertson, 1994; Robottom & Hart, 1995; Schooler, 1996; Wu & Smith, 1997). Cultures historically encoded the relationships among individuals and society, nonhuman organisms, and the environment. The political ideology and social structure of certain cultures affects individuals' environmental decision making and values. Economic situations in a cultural context also appeared to influence the individuals' values, beliefs, and behaviors. Therefore, understanding the cultural background is crucial when exploring children's views of the environment.

Research Design

This bi-national comparative study explored the cultural influences on children's self-reported environmental actions, perceptions, and understandings; investigated the relationships among the behavioral, affective, cognitive, and demographic variables; and developed models of children's responsible environmental behavior (Huang, 2001). The cross-cultural comparison utilized a survey of Canadian and Taiwanese grade 5 children. The following research questions guided the development of the questionnaire, data collection, and data interpretation:

1. What are children's self-reported environmental behaviors, attitudes, concerns, emotional disposition toward the environment and environmental knowledge in Canada and Taiwan?
2. What situational factors are reported as causing children's irresponsible environmental behavior in Canada and Taiwan?
3. What is the effect of demographic factors (e.g., gender, father's education, mother's education, and personal nature experience) on children's reported responsible environmental behavior, environmental attitude, environmental concern, emotional disposition toward the environment, and environmental knowledge in Canada and Taiwan?
4. Do children in Canada and Taiwan report different environmental behaviors, environmental attitudes, environmental concerns, emotional dispositions toward the environment, and environmental knowledge?
5. What associations exist between responsible environmental behavior and environmental attitude, environmental concern, emotional disposition toward the environment and environmental knowledge in Canadian and Taiwanese children?
6. Does the proposed children's responsible environmental behavior model predict children's responsible environmental behavior in Canada and Taiwan?

The design, instrument development, data analysis, and results required a clear understanding of the embedded constructs of the proposed model and of the sociocultural and environmental contexts of the selected samples of children.

Responsible Environmental Behavior

Responsible environmental behavior (REB) involves individuals' actions to protect and improve the environment with a recognized and available variety of actions (Hsu & Roth, 1998). An individual's behavior benefits self and society, and it promotes well-being of the environment. REBs are generally categorized by several environmental actions: ecomanagement, consumer/economic, legal, political, and persuasion (Hsu & Roth, 1998). Marcinkowski and Rehring (1995) indicated that ecomanagement refers to the action through which individuals physically help to prevent or solve environmental problems (e.g., planting flowers or trees, recycling, energy conservation). Consumer/economic action is an activity through which people protect the environment

or solve environmental problems by monetary support or by putting financial pressure on the related institutions (e.g., boycotts, selective or conservationary uses of goods or services, donating money to environmental groups). Political action is an activity through which people help to prevent or resolve environmental issues by utilizing their political rights (e.g., voting, participating in concerns for environmental problems). Legal action is an activity through which people use the law related to environmental protection to help alleviate environmental problems (e.g., lawsuits, reporting pollution violations to authorities). Persuasion is action through which individuals personally or collectively convince others to protect the environment or resolve environmental issues (e.g., argumentation, debate, motivating others by individual or group means, informal discourse).

Several studies have described the relationships among the environmental behaviors and other variables. Culen and Volk (2000) measured REB and other factors by using questionnaires with grades 7 and 8 students. REB was defined by four subcategories: persuasive action, political action, consumer action, and ecomanagement action. Smith-Sebasto and D'Acosta (1995) explored the same relationships with undergraduate university students; they identified an additional dimension of environmental behavior called educational action. Educational action refers to the activities through which people aim at acquiring environmental knowledge (e.g., reading newspapers, books, or magazines, watching environmental or science programs on TV). Kuhlemeier, Bergh, and Lagerweij (1999) studied grade 9 students' REB, defined as friendly action toward the environment regarding environmental issues that can be incorporated in daily life, such as consumption (consumer action), recycling (ecomanagement), and refuse-littering behaviors (ecomanagement). Environmental activists are people who are more aware of environmental issues and engage in more REB than non-activists (Doug et al., 1995; Seguin et al., 1998). Seguin et al. (1998) described activists' REB as participating in events organized by ecological groups (political action), circulating a petition demanding an improvement of government policies regarding the environment (political action), participating in protests against current environmental conditions (political action), helping to financially support an ecological group (economic action), voting for a

government proposing environmentally conscious policies (political action), and writing letters to companies that manufacture harmful products (persuasion).

Model of Children's Responsible Environmental Behavior

Numerous researchers have studied people's social behavior and sought to develop predictive models of such behavior. A traditional model assumes that an individual's REB will be developed by simply enhancing knowledge about nature and the environment. However, several researchers indicated there was no simple linear progression from knowledge to informed action (Dillon & Gayford, 1997; Seguin et al., 1998; Widegren, 1998). Based on a meta-analysis of research studies (Hines et al., 1987) and a comprehensive review of the recent literature (Huang, 2001), a more complex model of Children's REB was proposed to guide the development of instruments and data analyses (Figure 1). Intention to act is a prerequisite to action (Ajzen, 1988). People who have an intention to act perform more positive REB than those who do not (Hines et al., 1987). However, the intention to act is influenced by several variables. Environmental knowledge (EK) is one of those important cognitive variables that influences how individuals encounter and how they resolve environmental problems. EK includes information about environmental issues and action strategies needed to solve environmental problems. Action skills are the outcome of the people applying their knowledge in actual practice. But EK alone is not enough to nurture individual's REB; people's attitudes, locus of control, and personal responsibility interact with EK to influence REB. Individuals who have a positive attitude toward the environment, an internal locus of control, and a sense of obligation toward the environment tend to behave responsibly. Three affective variables were identified in the Children's REB (CREB) model; environmental attitudes (EATT), environmental concerns (EC), and emotional dispositions toward the environment (EDE). Although people may have sufficient knowledge and action skills and have a great intention to act, they still might not perform responsibly due to lack of time, inconvenience, or living in a context that ignores environmental issues. These situational factors (SF) and demographic factors (DF) might influence REB.

[Insert Figure 1 here]

Sociocultural Contexts

Social and cultural values, beliefs, and practices of society, community, and family influence children's personal and affective dispositions. Although most people in East Asia do not realize it, the hereditary thinking based on Confucian philosophy anchors and deeply influences their attitudes and actions (Chen & Chung, 1994; Chen et al., 1992; Hsue & Aldridge, 1995; Smith, 1997). Societies in East Asia are group-centered. Individuals grow up being taught the importance of acting obediently and conforming to common expectations in order to maintain harmonious relationships with others. Conservatism and cooperation are the main social norms in Asian culture (Quoss & Zhao, 1995; Steward et al., 1998). These are the essential extensions of Confucian thinking — filial obedience. Currently, Taiwan is concentrating on economic growth and political change. Although Taiwan has changed its public sociocultural characteristics by assimilating Western culture, Confucian philosophy and influence still resiliently exist in the private family characteristics.

On the contrary, Western countries are individual-centered societies and children have developed their free will to be independent and responsible individuals (Kuo et al., 1979; Tseng, 1972). Kuo et al. (1979) found that Chinese participants in a study had more thoughtful and scrutinized attitudes in confronting a task, while American participants solved the same task imaginatively and spontaneously. This result suggests Chinese participants lack confidence and hesitate to take actions when confronting problems.

There are different interpretations of parenting and parental responsibility between East Asia and North America. The family is the first social context in which children are involved; therefore, children's socialization is generated through family communications. Parents' beliefs, attitudes, and parenting styles affect children's confidence, assertiveness, and behavior (Gauvain & Huard, 1999; Hortacsu, 1995; Ma & Bateson, 1999; Palan, 1998; Skogen, 1996; Steward et al., 1998; Wilson & Wilson, 1992). Eastering et al. (1995) found that the four parenting styles (pluralistic, consensual, protective, and laissez-faire) created different family communications. Pluralistic and consensual families encouraged children to express their opinions and share their ideas; also children's thinking was more highly respected and valued. In consensual type families, individuals were more aware of family hierarchy and tried to avoid the possibility of

offending family members. Protective and laissez-faire type families did not promote interactions among family members, and children were not encouraged to initiate decision making and problem solving. While parents have more control and authority in rearing children in protective type families, laissez-faire type families have weaker family bonds between individuals.

Parents in Chinese families have culturally inherent authority, and children are expected to act obediently. Family closeness and loyalty are highly valued and are tied to parental authority. Listening is more important for children than is expressing their own opinions. The interaction between Asian parents and children is relatively conservative, and family communication in Asia is less important. Although traditional parenting in Taiwan is changing to be more democratic and children-centered, parental control and protection are predominant.

Chinese children are viewed as an extension of their parents, while North American children are inherently independent individuals (Hwang, 1998). Asian parents try to develop a protective environment for their children until they are adults, and North American parents tend to encourage their children to be independent and confident at a very early age. Chinese parents usually have rather high expectations for their children and their future success; they protect children in every aspect of their life in order to ensure these expectations are met. Chinese children, hence, are more inclined to develop dependence and reliance on their parents. American mothers attributed their children's making mistakes to external factors, while Taiwanese mothers considered that it was the fault of the children and children should be more self-disciplined and self-restrained (Chiang et al., 2000). Most Chinese and Japanese parents pay more attention to educating children in an academic orientation than in a social orientation, while American parents have more non-academic interactions and outdoor activities with their children (Stevenson et al., 1990). American parents believe children were born with their own ability and the children's future is earned by their own efforts. Chinese parents, on the contrary, believe studying hard makes everything possible and that is the only way to future success. They believe academic effort ensures a brilliant future for their children.

Environmental Contexts

Individuals' environmental perceptions are influenced by their physical environment (Dillon et al., 1999; Kahn & Friedman, 1995; Newell, 1997). Since this study explored the environmental knowledge, attitudes, concerns, emotional dispositions, and behaviors of children in two different island cultures, understanding the nature of Kaohsiung and Victoria's environments are essential. Kaohsiung, Taiwan and Victoria, Canada were selected for their similar geographical location on two similar sized islands (Taiwan: 36,188 sq.km; Vancouver Island: 31,285 sq.km). However, the population density in Kaohsiung (9,220 person/sq.km) is four and a half times more than that in Victoria (1,995 person/sq.km). The population density difference is more clearly illustrated by the realization that Taiwan's overall population density would be comparable to having Canada's total population confined to Vancouver Island. Although Kaohsiung and Victoria are both port cities located on the southern tip of the respective islands, there are unique differences.

Taiwan has been industrialized and urbanized along with rapid economic growth since martial law was lifted in 1987. The rapid economic development without much environmental consideration has dramatically changed the natural environment in Taiwan (Chan, 1993; Chang, 1998; Chen & Huang, 1998; Chin, 1993; Hsu & Roth, 1996; Tsai, 1999). Utilitarianism embedded in developing and industrializing countries inevitably leads to exploitation and degradation of nature (Furman, 1998). The environmental quality in Taiwan appears to have decreased with the increase in the nation's per capita income and massive foreign currency reserves. Although public awareness of environmental issues became a noticeable concern in Taiwan with the establishment of the Environment Protection Administration (EPA) in 1987 (Edmonds, 1998), Taiwan's government has been slow to put these laws into effect and to develop environmental education programs to protect the environment. Overall, it has been difficult to establish environmental protection that keeps pace with the economic growth; therefore, environmental protection and programs in Taiwan are far behind North America.

The population density of Taiwan, ranked the second highest in the world, causes a shortage of living space. Because of continuously shrinking living space, most people

live in deserts of concrete high-rises. Air and water pollution, soil erosion, and solid wastes are the major environmental problems in Taiwan.

Kaohsiung, one of the two municipalities of Taiwan (the other being Taipei), is an industrialized city made famous by its transition harbor. The city's four industries (petro-chemicals, cement, steel, and shipbuilding) allowed Kaohsiung to prosper economically, but this was accompanied by a low-quality environment. Polluted water requires residents to rely on bottled water purchased from other places instead of tap water. Air pollution from vehicles and industrial emissions seriously threaten people's health, especially their respiration systems, which is illustrated during rush-hour traffic by people and families of all ages on motor scooters wearing surgical masks. The combination of these and other pollution (e.g., acidification, noise, and contaminated soil) makes Kaohsiung a modern city with a fast-paced lifestyle characterized by convenience and an abundance of information, embedded in an undesirable environment.

Canada, one of the developed countries, relies heavily on its natural resources for developing its economy (Lutz et al., 1999). This is especially true in Western Canada. British Columbia, the western-most province of Canada, has the greatest biodiversity of birds, mammals, and forest ecosystems. Its water quality and forest resources are the pride of British Columbia — an ecoprovince (British Columbia Ministry of Environment, Lands and Parks, 1993). Economic prosperity in British Columbia has relied on logging due to the forest resources that cover 67% of the land. Because of the mild weather on the west coast and Vancouver Island, the unique natural environment and abundant job opportunities, people have been attracted to British Columbia. However, over the past decade, rapidly diminishing forest and fishery resources has resulted in decreased job opportunities in many sectors. Nonetheless, people tend to migrate and immigrate and to stay in British Columbia causing the provincial population to increase. Consequently, the increased population has caused greater human impact on the environment. Large cities of southern British Columbia are urbanized and industrialized, making environmental impairment difficult to avoid. Water and air pollution, solid wastes, and toxic chemicals caused by industry, agriculture or domestic practices are the main environmental problems. The issue on keeping a balance between economic growth and environmental protection in Canada is controversial.

Victoria, the capital city of British Columbia, is one of several urbanized cities in British Columbia. It is world famous for beautiful gardens and a peaceful, slow lifestyle, which is illustrated by people and families of all ages walking, running, and playing among the flowers, trees, and ponds of the central park located by the ocean. Environmental pollution is much less serious in Victoria than that in other parts of the province. In general, with the growth of people's environmental awareness and a willingness to change their lifestyle to improve their environment, the environmental situation in Victoria is still above the environmental standard of other cities in Canada (British Columbia Ministry of Environment, Lands and Parks, 1993; Goverment of Canada, 1996; Runnalls, 1992; Snively & Sheppy, 1991; Statistics Canada, 1994; Tolba, 1988).

Instrumentation

The CREB model (Figure 1) was used as the theoretical framework to develop draft questionnaires for use with grade 5 students in Canada (English) and Taiwan (Mandarin). A series of strict procedures, consultations, and a pilot study were utilized to develop and verify the questionnaires' validity and internal consistency. Verification of the questionnaires consisted of inquiries to explore and improve the psychometrics. The development of the item pool for the questionnaire followed a strict adherence to the CREB model and established research results. Development involved identifying a pool of potential questions from published instruments and selection was based on the fit with the CREB model. Resulting pools for each component in the model were judged for sufficiency and any components with potentially too few items to form valid and reliable subscales were supplemented with questions developed by the authors. The pool of items was submitted to a science educator and an environmental educator for comments and additions. This was done to establish construct and face validity. The selected items were translated into Mandarin and later back-translated into English to ensure the conceptual and communication integrity of the questions. A pilot study involving 48 Canadian students from Victoria and 75 Taiwanese students from Kaohsiung was conducted to explore readability, structure validity, and reliability. The draft questionnaires were revised based on the feedback and the factor analyses and internal consistencies to produce final questionnaires that consisted of seven parts corresponding to the

components of the CREB: demographics, behavior, attitudes, concern, emotional disposition, situational influences, and knowledge.

Part 1: Demographic Factors (DF) consisted of 6 items (5 items in the Mandarin version). The items referred to personal information about gender, nationality, parents' education, information sources, and nature experiences.

Part 2: Responsible Environmental Behavior (REB) consisted of 10 Likert-type items about children's physical and oral actions. Children were requested to indicate their behavior on a 5-point scale ranging from always to never (e.g., 1 = always, 2 = usually, 3 = sometimes, 4 = hardly ever, 5 = never). The behaviors were limited to the activities that children were likely to demonstrate in daily life. Considering the limited experience grade 5 students have with civil rights, political and legal action were excluded from the questionnaire. Observable and concrete behaviors were selected, such as the behaviors of saving resources (e.g., "How often do you use more tap water than is strictly necessary?"). The REB subscale was designed around items selected and adapted from established instruments to facilitate connections to other studies (Musser & Diamond, 1999; Musser & Malkus, 1994). The items addressed ecomanagement, consumer action, persuasion, and oral commitment of action.

Part 3: Environmental Attitudes (EATT) consisted of 9 Likert-type items using a 5-point response scale (strongly agree to strongly disagree) designed to measure children's affective dispositions toward nature and the environment using established and new items. Three dimensions were embedded in the EATT subscale: individuals' values toward nature and the environment (Dunlap & Van Liere, 1987; Dillon & Gayford, 1997), children's motivation regarding daily environmental action (e.g., "I save energy or recycle when others want me to do it; otherwise, I won't do it."), and children's confidence toward improving the environment (e.g., "I believe it will be greatly helpful to save energy if I always turn off the heat when leaving the room.").

Part 4: Environmental Concern (EC) consisted of 12 Likert-type items using a 5-point response scale (very worried to not worried at all) about children's sensitivity toward environmental problems and awareness of their perspective about certain environmental issues. The EC items focussed on concerns about environmental problems mutually

identified for Canadian and Taiwanese in the pilot study (e.g., acid rain and deforestation).

Part 5: Emotional Disposition toward the Environment (EDE) consisted of 6 Likert-type items using a 5-point response scale (strongly agree to strongly disagree) about children's emotions toward current environmental situations. The EDE items were selected from or based on items such as "I fear the effects of pollution for myself" (Szagun & Pavlov, 1995; Musser & Malkus, 1994).

Part 6: Situational Factors (SF) consisted of 4 items that referred to the reasons that prevent respondents from acting responsibly. The SF items identified from the pilot study provided several multiple responses, and the respondents were asked to choose the appropriate responses. More than one choice was allowed.

Part 7: Environmental Knowledge (EK) consisted of 16 items and was designed to assess knowledge of environmental issues and ecology foundation knowledge. These selected or adapted multiple-choice items (Leeming & Dwyer, 1995) addressed environmental issues of water, air, and pollution (e.g., "Most air pollution in our big cities comes from: A. cars, B. jet planes, C. factories, D. big trucks, E. landfills.") and fundamental ecological knowledge (e.g., "A species that no longer exists is: A. protected, B. endangered, C. abundant, D. extinct, E. wild game.").

Selection of Participants

The central focus of this study was children's environmental behaviors, attitudes, concerns, emotional dispositions, and knowledge from two distinctly different cultures and countries: Canada and Taiwan. In an attempt to control some potential influences, similar regions of Canada and Taiwan were identified: Greater Victoria on southern Vancouver Island and Kaohsiung on the southern part of the island of Taiwan. Both greater Victoria and Kaohsiung are located on the ocean and have an active harbor. However, the population of Victoria (317,500) is 4.7 times smaller than that of Kaohsiung (1,490,560); and the economic focus of these two cities is different (Victoria: Government and tourism; Kaohsiung: heavy industry and shipping). Grade 5 children from elementary schools were recruited to participate in this study. School districts, elementary schools, and students from greater Victoria and Kaohsiung were asked to volunteer for this study. Central district office staffs were contacted, and school district

approval was acquired. Once school district approval was received, elementary school principals were contacted to accquire school approval. Finally, grade 5 teachers in schools that agreed to participate were identified by the principals; and their students became potential participants in the survey. All student participants were required to have personal and parental permissions before participating in this research.

Data Collection

The survey was conducted from the middle of November 2000 to early March 2001. Timing was adjusted to account for the different school schedules in Canada and Taiwan. Canadian schools were closed for winter holiday from the middle of December to early January. Taiwanese schools were closed during the three-week national holiday for the Chinese New Year from January 23 to February 22, 2001. Therefore, the survey was conducted in Kaohsiung from the middle of November to late December 2000 and in Victoria from the middle of January to early March 2001.

Positive responses were received from 15 schools in 7 out of 15 geographic regions in Kaohsiung. The schools and geographic regions represented a reasonable cross-section of the quality of schools and the social economic levels in Kaohsiung. The survey in Kaohsiung was conducted either by the first author or home room teachers. Teachers were briefed by the first author about the administration procedures for the questionnaire. One class from each participating school completed the questionnaire. All participants in a class completed the questionnaire on a specific day. Most students were able to complete the task during the available time.

After obtaining permission from the Victoria and Sooke School District superintendents, elementary principals were asked to participate in the study by telephone. Positive responses were received from 12 schools, 7 from the Victoria School District and 5 from the Sooke School District. These schools represented a reasonable cross-section of schools and social economic levels in the two school districts. The survey packages including consent forms and questionnaires were delivered by the first author to the schools, and the survey was conducted by classroom teacher in each school. Written instructions for the administration of the questionnaire were provided for the teachers. The teachers conducted the survey in their classrooms at times convenient to

their instructional program and schedule. Completed forms and questionnaires were returned by Canada Post or picked up by the first author.

Data Analysis

Preliminary analysis of the questionnaire responses established the final composition of the questionnaire by addressing the status of five tentative items identified in the EK subscale during the pilot study. Factor analyses, internal consistency, item difficulty, and discrimination were conducted on the questionnaire responses from Canada and Taiwan. The results of these analyses supported the deletion or retention of items in the survey.

Descriptive statistics, t-tests, correlation analyses, and multiple regressions were conducted on the Canadian and Taiwanese data. Descriptive statistics were provided to document the general environmental behaviors, attitudes, concerns, emotions and knowledge of the Canadian and Taiwanese grade 5 children. A series of t-tests were used to determine whether significant differences existed between the two groups of children's responses by gender, parents' education, nature experience, and country. Correlation analyses were used to explore whether significant associations exist among REB, EATT, EC, EDE, and EK in the two countries. Multiple regressions was used as a path analysis to verify the CREB model, to determine the variables mediating and directly influencing children's REB, and to construct alternative models for Canadian and Taiwanese grade 5 children's responsible environmental behavior.

Results

Canadian grade 5 students (N = 278) from the greater Victoria school districts and Taiwanese grade 5 students (N = 506) from the Kaohsiung school regions participated in this research. Data from 278 students in Victoria (97% of Canadian sample) and 483 students in Kaohsiung (95% of Taiwanese sample) were statistically analyzed after incomplete questionnaires and responses from participants who were not Taiwanese nationals or who had not been born in Canada of non-Asian parents were excluded.

Verification of the CREB Questionnaire

The CREB questionnaire included four Likert-type subscales (responsible environmental behavior, environmental attitudes, environmental concern, and emotional disposition toward the environment) and one cognitive subscale (environmental knowledge). Separate factor analyses were conducted on the grade 5 children's responses

to explore the structural validity of the four Likert-type subscales and the multiple-choice subscale. Item-to-total correlations were applied to supplement the exploration of validity for the cognitive subscale. Cronbach's Alphas were determined to examine the internal consistency of the five subscales.

A prescribed four-component factor analyses with varimax rotation of the Canadian children, Taiwanese children, and combined data supported the structural validity of the questionnaire. Results for the combined data set indicated reasonable structural validity for the questionnaires: Environmental Concern (EC, 12 items) formed factor #1 with loadings from 0.43 to 0.71; Emotional Disposition toward the Environment (EDE, 6 items) formed factor #2 with loadings from 0.56 to 0.79; Responsible Environmental Behavior (REB, 10 items) formed factor #3 with loadings from 0.33 to 0.66; and Environmental Attitudes (EATT, 9 items) formed factor 4# with loadings from 0.37 to 0.66.

Analysis of the combined responses to the Likert-type subscales yielded reasonable high internal consistency. The range of alpha coefficients for the subscales was from 0.65 to 0.87. Cronbach's Alpha indicated that the reliability of REB subscale was 0.74 (Canadian = 0.70, Taiwanese = 0.75), EATT subscale was 0.65 (Canadian = 0.74, Taiwanese = 0.63), EC subscale was 0.86 (Canadian = 0.88, Taiwanese = 0.82), and EDE subscale was 0.85 (Canadian = 0.89, Taiwanese = 0.86). The reliability of the Likert-type CREB questionnaire was 0.87 (Canadian = 0.89, Taiwanese = 0.85).

Validity of the EK subscale was established by the combined evidence of face validity and structural validity. Structural validity was partially established by using a prescribed 1-component factor analysis that revealed a unified component with positive loadings. Five items did not reach the criterion value = 0.30 but were retained based on their central importance to issues in other subscales (Items #2, #6, #11, #12, #13). Item-to-total correlations were then conducted to analyze each item's association to the unified component. Significant ($r > 0.07$, $p \leq 0.05$, $N \geq 500$) positive correlations ranged from 0.28 to 0.53. The combined evidence of the expert judgment, factor analysis, and item-to-total correlations suggested a reasonably valid knowledge subscale of 16 items. The reliability of the EK subscale was explored using the Cronbach's Alpha; this analysis

indicated the internal consistency was 0.56 (Canadian = 0.62; Taiwanese = 0.52). The psychometrics of the EK subscale were judged to be reasonable for this low-risk survey.

Descriptive Statistics

Demographic information included gender, parent's education, sources of information, and the kinds and frequency of nature experiences participated in over the last year. The Canadian participants included 118 males (42.5%) and 160 females (57.6%). The Taiwanese participants included 243 males (50.3%) and 240 females (49.7%).

Parents' Education. Children's uncertainty about their parents' education level was the major reason for missing data. The uncertainty was of greater concern for the Canadian children who were infrequently asked to indicate their parents' education. Due to the large sample size for the surveys from the two countries (Canada = 210; Taiwan >450), the small amount of missing data was judged to be insignificant; and the usable sample sizes were accepted in the demographic part of this study. In the final data analysis, parents' education level was classified into two categories (below university and some university) in an attempt to maximize the validity and reliability of these responses. Most Canadian fathers (76.8%) had some university level education, while most Taiwanese fathers (62.8%) did not have university level education. Most Canadian mothers (76.3%) had some university level education, while most Taiwanese mothers (74.5%) did not have university level education. In general, Canadian parents appeared to be more educated than Taiwanese parents. The Canadian results must be viewed with skepticism since university degrees are reported by only 13.6% of British Columbia residents and the range of values for greater Victoria residents is 9.6% to 29.3% holding university degrees (Bell, 2001; Curtis, 2001; Danard, 2001; Wilson, 2001; Young, 2001).

Sources of Environmental Information. Generally, the results about top and bottom ranked sources of environment information were similar for Canadian and Taiwanese children. Canadian children reported that TV (79.3%), their family (71.6%), teachers (68%), and books (59.6%) were the most frequent sources of environmental information. Taiwanese children reported TV (90.7%), teachers (69.8%), the newspaper (60%), and their family (58.8%) were the most frequent sources of environmental information. Canadian children reported that speeches (14.9%), brochures (17.8%), magazines

(32.7%), and posters (33.5%) were the least common sources of environmental education. Taiwanese children reported that speeches (28.4%), magazines (29.2%), brochures (30.9%), and posters (35.2%) were the least common sources of environmental education.

Nature Experiences. Information on children's nature experiences was obtained by inquiring about the frequency and types of nature activities they had participated in last year. The information obtained in this study provided an approximate picture of children's activities and participation. Generally, the Canadian children participated in more nature activities than Taiwanese children. Most Canadian (93.2%) children reported participating in at least one environmental activity during the last year. Camping (78.8%), hiking (77.7%), and picnicking (66.9%) were the most popular activities. A smaller majority of Taiwanese children (77.9%) reported participating in at least one environmental activity during the last year. Picnicking (58.4%), camping (55.7%), and hiking (50.3%) were the most popular activities.

Nature experiences were classified into three categories: frequent, sometimes, and seldom. Children who reported joining more than three types of activities ≥ 6 times the previous year were categorized as frequent participants. Children who participated in 1 or less types of activity ≤ 2 times the previous year were categorized as seldom participants. The remaining children were categorized as sometimes participants. Most Canadian children were frequent participants (56.5%), 30.2% were sometimes participants, and 13.3% were seldom participants. Only 33.3% of Taiwanese children were frequent participants, 26.5% were sometimes participants, and 40.2% were seldom participants. In summary, Canadian children experienced nature more diversely and more frequently than Taiwanese children.

Environmental Behavior, Attitudes, Concerns, and Emotional Dispositions. The higher REB composite score indicates that the individual had more positive behavior toward the environment. Scores above 30 were considered responsible environmental behavior. The REB mean score for Canadian children was 33.32 (SD = 6.07) and for Taiwanese children was 36.37 (SD = 6.58). Generally, grade 5 children in both countries had positive REB.

A higher EATT score indicates more positive attitudes toward the environment. The EATT subscale consisted of environmental values, motivation on action, and confidence on action. EATT scores ranged from 9 to 45, and a positive score was considered to be above 27. The mean EATT score was 33.93 (SD = 6.64) for Canadian children and 33.55 (SD = 6.11) for Taiwanese children. Positive and hopeful environmental attitudes were found in children from both countries.

EC referred to children's expressed level of worry about the current environmental problems, such as water pollution and acid rain. Higher scores indicated greater levels of concern about these environmental problems. The range of EC scores were from 12 to 60; individual scores above 36 were considered highly concerned. The mean EC score of Canadian children was 50.49 (SD = 8.15) and of Taiwanese children was 54.59 (SD = 5.75). These values indicated that Canadian and Taiwanese children generally were highly concerned about environmental problems.

Among the 12 local and global environmental problems that Canadian children were worried or very worried about are extinction of animals and plants (92.5%), water and river pollution (87.8%), and air pollution (87.1%). Taiwanese children were worried or very worried about air pollution (95.2%), water and river pollution (94.6%), and the extinction of animals and plants (93.6%). The overpopulation problem was of least concern for both Canadian and Taiwanese children. The results indicated a similar pattern of concern for Canadian and Taiwanese children about certain environmental problems.

EDE referred to individuals' expression of fear and anger about current environmental issues. The higher the EDE score, the more anger and fear children expressed. The EDE scores ranged from 6 to 30. Scores above 18 were considered strong emotional disposition of fear or anger. Canadian children's mean EDE score was 24.73 (SD = 4.95) and Taiwanese children's was 25.30 (SD = 5.87). Most Canadian children (80.9%) were fearful about the effects of pollution on their own health and were afraid to live without trees and animals (80.2%). Most Taiwanese children (82.8%) were angry about the industrial pollution of the environment and highly afraid that pollution would have a negative influence on their own health (81.6%). Children in both countries expressed strong emotional disposition toward the environment in general and specific environmental situations (Table 1).

Table 1. Children's Emotional Disposition toward the Environment toward the Environmental Issues

Environmental Issues	Percentage of Strong Dispositions	
	Canadian (N = 278)	Taiwanese (N = 483)
Fear more pollution and disasters in the future	69.2%	78.5%
Fear of the living environmental without trees and animals	80.2%	78.0%
Fear of the pollution influence on their own health	80.9%	81.6%
Being sad about what people did toward nature	79.9%	78.0%
Angry at the industry polluting the environment	78.1%	82.8%
Angry at adults' less effort on improving the environment	69.1%	78.5%

Environmental Knowledge. The EK subscale considered specific issues (energy, animals, recycling, water and air pollution, and food chain) and general issues. The mean EK score of the Canadian children was 9.99 (SD = 2.99) and of the Taiwanese children was 10.78 (SD = 2.29). The average percentage correct rate for Canadian children was 62% and that of Taiwanese children was 67%. The test scores revealed that Canadian and Taiwanese children had moderate knowledge about ecology and the environment issues.

Irresponsible Environmental Behavior. Four items in the survey were designed to explore situational factors that might influence children to take irresponsible environmental behavior. These items also assessed reasons for such negative environmental behavior: inconvenience, forgetfulness, unsupportive social environment, and personal reasons. Canadian and Taiwanese children reported similar reasons for their irresponsible environmental behavior. Many Canadian children (48.9%) and Taiwanese children (43.7%) reported that they always remembered to recycle plastic or glass bottles, when the others were asked why they did not recycle plastic or glass bottles. "I forgot" was the most frequent reason reported (33.8% of Canadian children, 24.9% of Taiwanese children). When asked about why they drop candy wrappers in a park or playground, 71.1% of Canadian and 61.3% of Taiwanese children indicated they always found the garbage can to drop it. "No garbage cans were around" (inconvenience) was the major reason given for the irresponsible behavior by 12.6% of Canadian children and 17.0% of Taiwanese children. Asked why they did not turn off the light when leaving a room, 43.3% of Canadian children and 62.5% of Taiwanese children always remembered to turn off the light. "I forgot" was the major reason given for the irresponsible behavior by

49.1% of Canadian children and 25.7% of Taiwanese children. When asked about why they did not clean up the place where they live, 45.9% of Canadian children and 49.9% of Taiwanese children indicated they always remembered to clean up their place. "I forgot" was reported as the reason for not cleaning up by 28.9% of Canadian children and 20.1% of Taiwanese children.

In general, these results suggested that Canadian and Taiwanese children report similar situational behaviors and similar factors causing their irresponsible behaviors. The major reasons given for irresponsible environmental behavior were forgetfulness and inconvenience, implying the REB was not fully developed as part of the children's habits. Children still need to be reminded to maintain their positive environmental behavior. Inconvenience was another reason, suggesting that children's positive environmenetal behavior might be impeded if the difficulty of demonstrating REB increased.

Differences for Demographic Groups within the Canadian and Taiwanese Groups. Student's t-tests were applied to evaluate the existing differences in REB, EATT, EC, EDE, and EK by demographic variables (gender, father's education, mother's education, and nature experience). In the case of nature experience, the differences between the two extreme groups (frequent and seldom) were analyzed since the middle group (sometimes) did not demonstrate a well-defined composition. Pooled variance t-tests were used in the cases with homogeneity of variance and separate variance t-tests were used in the cases with non-homogeneity of variance.

The REB scores were found significantly ($p < 0.01$) different by gender and nature experience in both countries. The significant gender difference indicated that girls in both countries had more positive REB than boys. Children with frequent nature experience had more positive REB than children with seldom nature experience. A significant ($p < 0.05$) difference existed for father's education in the Taiwanese children's REB. Higher father's education appeared to have a positive influence on children's REB scores.

The EATT scores were significantly ($p < 0.01$) different by gender in both Canadian and Taiwanese children. Girls' attitudes scores were significantly more positive than boys' scores in both countries. Canadian children with different nature experiences had significantly ($p < 0.01$) different EATT scores. Children with frequent nature experiences had higher EATT scores than children with seldom nature experiences. Taiwanese

children's EATT scores were significantly ($p < 0.05$) different by parents' education. Children with higher father's and mother's education demonstrated higher EATT scores than children with parents having lower education.

The EC scores were significantly different by gender and nature experiences in both Canadian ($p < 0.01$) and Taiwanese ($p < 0.05$) children. Girls in both countries were significantly more concerned about environmental issues than boys. Children with frequent nature experiences were significantly more concerned about the environment than children with seldom nature experiences.

The EDE results indicated significant ($p < 0.01$ or $p < 0.05$) differences existed by gender and nature experiences in both Canadian and Taiwanese groups. Girls in both countries had higher EDE scores than boys. Children in both countries with frequent nature experiences had higher EDE scores than children with seldom nature experiences. Futhermore, there were significant ($p < 0.01$) EDE differences in Taiwanese children with different parents' education. Children whose father and mother had higher education had higher EDE scores than children whose parents had lower education.

Significant ($p < 0.05$) differences in EK scores for nature experiences groups were found for Canadian and Taiwanese children. Children in both countries with frequent nature experiences had higher EK scores than children with seldom nature experiences. Taiwanese children's EK was found to be significantly ($p < 0.01$) different by parents' education. Children whose parents had higher education had higher EK scores than children whose parents had lower education.

Differences between the Canadian and Taiwanese Children. Two group t-tests (Table 2) revealed that Canadian children's scores on EB, EC, and ED were significantly lower

Table 2. Comparison of Environmental Performance on Canadian (N = 278) and Taiwanese Children (N = 483)

Environmental Variables	Mean, Standard Deviation		t-value
	Canadian	Taiwanese	
Environmental Behavior (REB)	33.32, 6.07	36.37, 6.58	6.34**
Environmental Attitudes (EATT)	33.93, 6.64	33.55, 6.11	-0.80
Environmental Concern (EC)	50.49, 8.15	54.59, 5.75	8.11**
Emotional Disposition (EDE)	24.73, 4.95	25.30, 5.87	1.37
Environmental Knowledge (EK)	9.99, 2.79	10.77, 2.29	4.23**

** significant level $p < 0.01$

than those of Taiwanese children. No significant differences between Canadian and Taiwanese children were found for EATT and EK.

Associations among the Environmental Performance Variables for Canadian. Pearson product-moment correlations were conducted to reveal the associations among the environmental variables. Significant associations ($r > 0.14$, $N \geq 200$, $p < 0.05$) existed among all environmental variables for the Canadian children. The correlations between REB (central outcome variable) and other environmental variables (predictor variables) from highest to lowest were: REB and EDE ($r = 0.54$), REB and EC ($r = 0.45$), REB and EATT ($r = 0.26$), and REB and EK ($r = 0.23$). The correlations among the environmental variables were positive and reasonable (0.16 to 0.42), except the correlation between EC and EDE ($r = 0.77$). The high correlation between EC and EDE might suggest the similarity existing in EC and EDE measurements that might cause the redundancy on measuring environmental performance. This could cause imprecision in the multiple regression analyses regarding the path analysis of CREB model.

All environmental variables were significantly correlated ($r > 0.09$, $N \geq 400$, $p < 0.05$) for Taiwanese children. The correlations between REB (outcome variable) and other environmental variables (predictor variables) from the highest to the lowest were: REB and EC ($r = 0.36$), REB and EDE ($r = 0.30$), REB and EATT ($r = 0.17$), and REB and EK ($r = 0.17$). The correlations among the environmental variables were all positive and reasonable (0.26 and 0.43). These results revealed similarities for the correlations between the outcome variable and the predictor variables found for the Canadian children, but there were no extremely high correlations among the predictor variables.

Models of Responsible Environmental Behavior. Multiple regressions applied systematically can function as a path analysis to verify theoretical models or to experimentally build models (Pedhazur, 1982; Seguin, et al., 1998; Widegren, 1998). The CREB model based on the literature review was tested by applying a path analysis using unrestricted multiple regressions of predictor variables onto the outcome variable — responsible environmental behavior. Preliminary tests of multicollinearity and singularity among predictor variables were necessary before any regression analyses were conducted. Multicollinearity was explored in terms of judging the tolerance values.

Singularity was explored in terms of judging correlations among independent variables. High tolerance values and moderate correlation coefficients among the independent predictor suggested the absence of multicollinearity and singularity among these variables for both nationality groups. Only EC and EDE for Canadian children were highly correlated ($r = 0.77$), and the tolerance values of EDE (0.40) was rather low. The potential redundancy might cause inaccuracy in the regression analysis, and results should be interpreted with cautions for the Canadian CREB model.

The CREB model for grade 5 Canadian children was verified using an unrestricted multiple regression analysis. Predictor variables including all environmental variables (EATT, EC, EDE, and EK) and all demographic variables (gender, father's education, mother's education, and nature experience) were entered to determine the direct influences on REB. Only EDE and gender significantly associated with REB.

A restricted regression analysis utilizing these significant predictors (EDE and gender) revealed the variance explained in REB ($R^2 = 0.32$, $F[2, 275] = 64.93$, $p < 0.01$). The result suggested that 32% of variance in REB was accounted for by EDE and gender with standardized beta weights of 0.50 and 0.19. Females with high EDE appeared to act more responsibly toward the environment.

However, these results for Canadian children did not fully support the original CREB model. Therefore, further analyses were conducted to determine an alternative CREB model for Canadian children based on the current data. The three remaining non-significant predictors from the first analysis (EATT, EC, and EK) and all demographic variables (gender, father's education, mother's education, and nature experience) were entered to identify their predictive power for EDE. All demographic variables were utilized in each analysis to explore the influence of these extra-curricular variables on the curricular variables. Only EC was demonstrated to be a significant predictor of EDE. A restricted regression analysis was conducted in which only EC was entered to reveal the variance accounted for in these Canadian children's EDE ($R^2 = 0.59$, $F[1, 276] = 393.24$, $p < 0.01$). The result indicated that 59% of variance in EDE was explained by EC with standardized beta weight of 0.77. The result suggests that children's high concern about environmental problems might produce high EDE scores.

A similar multiple variable regression analysis entered the two remaining environmental variables (EATT and EK) and all demographic variables (gender, father's education, mother's education, and nature experience) to explore their predictive power for EC. Only EATT revealed significant linkage with EC. A restricted regression analysis that entered only EATT revealed the variance explained in EC ($R^2 = 0.11$, $F[1, 276] = 34.81$, $p < 0.01$) was 11% of total variance with a standardized beta weight of 0.34. Children with positive EATT might develop higher EC.

The next regression analysis entered the last environmental variable (EK) and all demographic variables to identify which variables were significantly associated with EATT. The result suggested EK and nature experience were significant predictors of EATT. A restricted regression that entered only EK and nature experience explored the variance explained in EATT ($R^2 = 0.21$, $F[2, 274] = 37.24$, $p < 0.01$). The results indicated that EK and nature experience accounted for 21% of total variance in EATT with the standardized beta weights of 0.40 (EK) and 0.19 (nature experience). Children with higher EK and with frequent nature experience appear to develop more positive EATT.

The final regression entered all demographic variables (gender, father's education, mother's education, and nature experience) to explore the significant predictors of EK. No significant predictors were found.

The results of the sequential regression analyses were combined to propose an alternative Canadian CREB model (Figure 2). The alternative CREB model constructed from these data suggests a single linear relationship among environmental variables while gender and nature experience were influential demographic variables. Parents' educational backgrounds did not influence the model of their children's responsible environmental behavior. This might be due to the children's inaccurate reporting of their parents' educational backgrounds. The Canadian CREB model indicated that REB is positively influenced by children's EDE, especially for girls. EDE appears to be highly influenced by EC. Children's anger and fear about environmental issues appear to increase when they have higher level of worry about the environment problems. Furthermore, increased EC appears to be influenced by EATT in which positive EATT might encourage children to pay more attention to their surrounding environment and

environmental problems. EATT appear to be positively influenced by increased EK and frequent nature experience. It appears as if more nature experiences with enhanced knowledge about the environment facilitate children's affinity toward the environment forming positive EATT. The sequential regression equations utilizing standard scores and coefficients yielded from the systematic multiple regression analyses illustrate the Canadian CREB model:

REB = 0.50 EDE + 0.19 Gender

EDE = 0.77 EC

EC = 0.34 EATT

EATT = 0.4 EK + 0.19 Nature Experience

[Insert Figure 2 here]

The CREB model for grade 5 Taiwanese children was established using a similar series of regression analyses as conducted on Canadian data. The original CREB model proposed was evaluated using an unrestricted multiple variable regression analysis of REB in which all environmental variables (environmental attitudes, environmental concern, emotional disposition toward the environment, and environmental knowledge) and all demographic variables (gender, father's education, mother's education, and nature experience) were entered. Two environmental variables (EC and EDE) and two demographic variables (gender and nature experience) were identified as significant predictors of REB.

A restricted regression analysis that entered EC, EDE, gender, and nature experience revealed 22% of the variance in REB ($R^2 = 0.22$, $F = [4, 478] = 34.60$, $p < 0.01$) was explained by these four variables with standardized beta weights of 0.28 (EC), 0.20 (EDE), 0.17 (gender), and 0.13 (nature experience). This result implied that girls with high EC, high EDE, and frequent nature experiences would have more responsible actions toward the environment.

Since these regression analysis results did not fully support the original CREB model, further regression analyses were conducted to explore alternative CREB models for the Taiwanese children. A restricted regression analysis entered the two remaining environmental variables (EATT and EK) and all demographic variables (gender, father's education, mother's education, and nature experience) to explore which variables were

significant predictors of EC. The result indicated that EATT, EK, nature experience, and father's education were significant predictors of EC. A follow-up regression analysis which entered only EATT, EK, nature experience, and father's education ($R^2 = 0.15$, $F = [4, 452] = 20.13$, $p < 0.01$) revealed that these predictor variables accounted for 15% of the variance in EC with standardized beta weights of 0.31 (EATT), 0.13 (EK), 0.10 (nature experience), and -0.09 (father's education). Children with positive EATT, high EK, frequent nature experiences, and a father with lower education were more concerned about environmental problems.

The next regression analysis entered two remaining environmental variables (EATT and EK) and all demographic variables (gender, father's education, mother's education, and nature experience) to explore whether these variables were significant predictors of EDE. The result indicated that EATT, EK, and gender were significantly associated with EDE. A restricted regression analysis that entered only EATT, EK, and gender revealed 13% of total variance in EDE ($R^2 = 0.13$, $F = [3, 479] = 24.05$, $p < 0.01$) was explained by these three variables with standardized beta weights of 0.20 (EATT), 0.21 (EK), and 0.09 (gender). The result implies that girls with positive EATT and high EK had high EATT.

A further regression analysis entered all demographic variables to explore the significant predictors of EATT. Only gender was the significant predictor of EATT. The restricted regression which entered gender ($R^2 = 0.02$, $F = [1, 481] = 12.05$, $p < 0.01$) revealed 2% of total variance in EATT was explained by gender with standardized beta weight 0.16 (gender). Girls tended to have more positive EATT than boys.

The last regression analysis explored the influences of the demographic variables upon EK. Only nature experience was identified as a significant predictor of EK. The results of this analysis revealed only 1% of total variance in EK can be explained by nature experience with standardized beta weight of 0.11 ($R^2 = 0.01$, $F = [1, 481] = 6.11$, $p < 0.05$). Children with more frequent experiences in nature had slightly higher EK.

The path analysis did not fully support the original model; therefore, the results were synthesized to construct an alternative Taiwanese CREB model (Figure 3). Responsible environmental behavior appears to be predicted by environmental concern and emotional disposition toward the environment, while environmental knowledge and environmental

attitudes appear to be influences on environmental concern and emotional disposition toward the environment. Nature experience, gender, and father's education appears to be influential demographic variables on Taiwanese children's REB, EC, EDE, EATT, and EK. The sequential regression equations utilizing standard scores and coefficients yielded from the systematic multiple regression analyses illustrate the Taiwanese CREB model:

REB = 0.28 EC + 0.20 EDE + 0.17 Gender + 0.13 Nature Experience

EC = 0.31 EATT + 0.13 EK + 0.10 Nature Experience - 0.09 Father's Education

EDE = 0.20 EATT + 0.21 EK + 0.09 Gender

EATT = 0.16 Gender

EK = 0.11 Nature Experience

[Insert Figure 3 here]

The Taiwanese CREB model suggests responsible environmental behavior might be promoted when children were more worried about environmental problems, more angry and fearful about environmental situations, and had more nature experiences, especially for girls. Children would be more concerned about environmental problems if they had positive environmental attitudes and more environmental knowledge, especially when they have fathers with lower education. Children's anger and fear might increase once their environmental knowledge increase, and environmental attitudes were more positive, especially for girls. Finally, children's environmental knowledge was enhanced by increasing nature experiences, while environmental attitudes were influenced by gender.

Discussion

The discussion will systematically consider the major findings of the study dealing with descriptive results, within group differences for specific demographic categories, between group differences, and the CREB model verification and alternative model construction for the Canadian and Taiwanese data sets. The discussion for each of these major dimensions will attempt to contextualize the findings and provide explanatory suggestions.

Information Sources

Media is a powerful influence on children's environmental beliefs, concerns, emotional dispositions, and behavior. Television was considered the major source for obtaining environmental information for children in both countries. Although TV is the

major education source for children's environmental learning, the information propagated by the media tends to be ambiguous, short, fragmented, and inevitably commercialized (Chafee, 1995; Clover, 1995; Fortner et al., 2000). Mass media usually focused narrowly on specific environmental issues and awareness (Bonnett & Williams, 1998; Hungerford & Volk, 1990). This selectivity and presentation style could result in the high environmental concern and high emotional disposition toward the environment expressed by children from both countries. Unfortunately, children's high concern about environmental problems did not exhibit equally high understandings about those environmental issues. Individuals tend to believe the information suggested by popular media without thinking critically about the claims (Phillips & Norris, 1999).

Family was a more important information source for Canadian children than for Taiwanese children, which might suggest that communications for Taiwanese families were not as prevalent as for Canadian families. Family interactions provided opportunities for children to clarify their environmental values by sharing and discussing their understandings with trusted family members. Quality communications in a family appear to involve mutual trust, respect, and equality between parents and children. Generally, parents' authority in East Asian society is still a barrier for free-flowing family communications. Asian parents ascribe sole responsibility for children's learning to the schools, thereby reducing the expectations for family disscussions about educational issues.

Barriers to Responsible Environmental Behavior

Inconvenience and forgetfulness are the main reasons causing children's irresponsible environmental behavior in both countries, although these children indicated relatively high responsible environmental behavior. Children's positive environmental behavior appears to be the result of conscious actions, while irresponsible environmental behavior is demonstrated unconsciously. Individuals' conscious actions are guided by rational thinking, deliberate monitoring, and understanding, while unconscious actions reflect individuals' habits. If the ultimate goal of environmental education is to develop an environmentally active and responsible citizenry, individuals' unconscious tendencies should be taken into account. Children's positive environmental behavior must be reinforced by doing, thinking, and justifying daily. The reason that responsible

environmental behavior was not rooted in children's daily life might be explained in terms of some children's lack of experiential learning or applied practice of environmental positive actions.

Demographic Differences within the Groups

Gender was an influence on most environmental performances of Canadian and Taiwanese children except for environmental knowledge. Girls' scores on REB, EATT, EC, and EDE were significantly higher than boys' in both countries. Girls acted more responsibly, have more positive attitudes, were more worried about environmental problems, and expressed higher fear and anger about current environmental situations. Females have been found to have more caring attitudes and empathy toward the environment than males (Skogen, 1996). Some researchers suggested that different responses by gender found in this study are the result of different parental and school expectations for girls and boys (Dietz et al., 1993; Gifford et al., 1982-1983; Jambunathan & Hurlbut, 2000; Lousley, 1999; Matthews, 1995; Thearle & Weinreich-Haste, 1986).

Parents' education level did not influence Canadian children's environmental performance, but some influences were suggested for Taiwanese children. The lack of influence found for Canadian parents' education might be the result of inaccurate reporting of parents' educational background by their children. The information about Taiwanese parents' educational background might be more accurate, since children in Taiwan were frequently asked about family background including their parents' education. The analysis results indicated that Taiwanese parents' education consistently and positively influenced children's environmental attitudes, emotional disposition toward the environment, and environmental knowledge. The family is the important source of information and the major sociocultural context for developing Asian children's socialization, beliefs, and values. Children learn environmental behavior and attitudes by direct experience or observing their family's behavior. Higher educated parents might have more positive behavior, and might be more knowledgeable about and more aware of environmental issues themselves, thereby providing children with a richer context and model. Furthermore, parents' education might be an indicator of social economic status. Parents with higher education levels might have a higher standard of living and,

therefore, are frequently able to provide more resources and opportunities for their children to learn about the environment.

Nature experience was the another influential variable on children's environmental performances in both countries except for the environmental attitudes of Taiwanese children. Children with more and diverse nature experiences tended to express more positively REB, EATT, EC, EDE, and EK scores. The results supported the environmental education assumption that individuals' participation in nature and experiential learning activities would have positive influences on their attitudes, knowledge, and behavior toward the environment. A previous study indicated that the environmental affinity mainly developed by experiencing the variety in micro-scopic or macro-scopic nature (Kals et al., 1999). Environmental affinity was found to be a substantial predictor of environmental protective behavior and to have long-term impact on individuals' environmental views.

If nture experiences were the single most influence on environmental responsibility, then the Canadian children's environmental performances should be more positive. However, the result of this research indicated Taiwanese children have more positive environmental performances that Canadian children. This inconsistent result could be interpreted in terms of the different natural context in Victoria and Kaohsiung. Children in Victoria live in abundant natural surroundings, while children in Kaohsiung are surrounded by skyscrapers and a people-built artificial environment. Kaohsiung was industrially developed by sacrificing the green suburban surroundings, and opportunities for experiencing nature are rare for Kaohsiung children. This rareness for going out into nature makes such experiences more appreciated and impressive for Taiwanese children. Thus, Taiwanese children appear to appreciate nature experiences more and have developed stronger bonds between environmental affinity and their environmental performances than Canadian children.

Comparisons of Canadian and Taiwanese Children CREB Scores

Canadian children expressed significant lower REB, EC, and ED scores than Taiwanese children. Taiwanese children's significantly higher environmental concern than Canadian children's might be caused by their dissatisfaction with their current living surroundings. Children living in the industrial-oriented city of Kaohsiung with its

undesirable environment have suffered from local environmental problems. Experiencing this environmental degradation has stimulated individuals to take action to protect the environment and to express worry about environmental problems. Surprisingly, these actions and concerns were reported without a significantly higher degree of fear and anger being expressed by Taiwanese children.

Although children's general environmental attitudes were not found significantly different between the two countries, Canadian children's confidence of action was significantly more positive than that of Taiwanese children. Confidence of action referred to individuals' belief in their own efforts to improve the environment. Taiwanese children's lower confidence of action might be the result from parenting styles, social conventions, and education. A similar result was indicated in the study of Horsley (1984).

Environmental attitudes, concern, emotional disposition, and behavior can be developed by social values, family education or media, while environmental knowledge appears to be influenced by school setting. Children relied heavily on teachers for obtaining environmental information. Teachers and educational policy in Taiwan's elementary schools utilize teacher-directed instruction with paper and pencil student work emphasizing knowledge, while Canadian schools appear to emphasize experiential learning activities and a balanced set of educational goals involving skills, processes, attitudes, values clarification, and knowledge. This may explain why Taiwanese children's EK mean score was higher than that of Canadian children. Environmental knowledge is less likely to be internalized and applied to solve relevant problems when meaningful learning is not stressed (Gambro et al., 1996). Children in Taiwan learned from a traditional curriculum without being provided relevant contexts; this approach might develop knowledgeable children without the competence to apply the knowledge to real environmental problems and issues.

Children's concern about the current environmental situation can be emotionally charged (Cade, 1989). This was found in Canadian and Taiwanese children's responses on EDE subscale. Strong and positive associations between REB and EDE subscales were found for both nationalities. This result is supported by previous studies (Kals et al., 1999; Szagun & Pavlov, 1995). The high emotional disposition did not lead to children's hopelessness and disempowerment regarding their behavior and attitudes. Children's

anger at the industrial pollution, the lack of action by adults to improve the environment, and fear of no plants and animals around in the future appeared to encourage them to take protective action toward the environment.

Models of Children's Responsible Environmental Behavior

Cultural differences were revealed between Canadian and Taiwanese CREB models. Environmental variables in the Canadian CREB model interacted linearly with each other, while environmental variables in the Taiwanese CREB model were related to multiple variables. The linear structure of the Canadian CREB model might impede the development of children's responsible environmental behavior if insufficient development exists in any of the environmental variables. On the contrary, multiple dimensions revealed in the Taiwanese CREB model provided supplementary relationships if any possibly insufficient development exists among these environmental variables. Thus, the insufficient development of any single environmental variable might have less impact on developing Taiwanese children's responsible environmental behavior.

Furthermore, Canadian and Taiwanese CREB models indicated that nature experiences for Taiwanese children were more important than for Canadian children. Nature experience significantly contributed to Canadian children's EATT, while it contributed to Taiwanese children's REB, EC, and EK. This might be due to the fact that the lack of experiential learning in Taiwanese schools makes this informal learning component more important.

The similarity was also revealed from the structurally different CREB models for Canadian and Taiwanese children. First, REB in both nationalities appears to be developed when children were fearful and angry about the current environmental situations. Second, EK in both CREB models was a less influential variable. The result indicated that children's REB was influenced more by affective variables (EDE for Canadian and EC, EDE for Taiwanese) than the cognitive variable (EK). The cognitive variable (EK) accounted for a very small percentage of variance in REB of Canadian and Taiwanese children (0.42% for Canadian, 0.34% for Taiwanese), while affective variables accounted for a much larger percentage of the variance in REB (32% for Canadian, 22% for Taiwanese).

Implications for Curriculum

Environmental education curriculum should increase children's global environmental knowledge based on their local environmental concerns – Think globally, act locally. Environmental knowledge was not a primary influence of environmental behavior in this study. This result implies that the cognitive component of the environmental education curriculum has not been emphasized or that the instruction does not emphasize meaningful learning. Children can not act rationally if their meaningful understanding of the environment is ignored. Since both Canadian and Taiwanese children are highly concerned about environmental problems and issues, it appears that teachers could engage students' learning with these issues to develop their relevant environmental knowledge in a meaningful way (Sale & Lee, 1972).

Environmental education programs need to develop children's ability to envisage a better future in elementary school and maintain it through the rest of their schooling. Children with high emotional disposition (anger and fear) might not be able to maintain their positive beliefs about environmental action and thereby become hopeless about the environment in the future. A sustainable environment can be developed only when individuals have an optimistic view toward the future. Individuals' positive environmental beliefs can be strengthened once the possibility of a better future is established. However, traditional environmental education rarely emphasizes a future vision (Hicks & Holden, 1995; Hutchinson, 1997).

Media literacy should be emphasized in environmental education curriculum (Filho & Banderia, 1995; Gough, 1996), since TV is the major environmental information source for Canadian and Taiwanese children. Media literacy should stress critical thinking and understanding to distinguish the purpose of and validity of certain environmental programs found on TV. Teachers need to bring several media programs into classroom discussions and to debate and appraise their contributions. Such comparative activities will not only stimulate critical thinking and pragmatic interpretation, but also prevent children from being negatively influenced by the mass media (Phillips & Norris, 1999).

The teachers' positive belief about their teaching effectiveness is the most important element to enhance classroom instruction. (Aldridge et al., 1999; Aubrey, 1996; Lumpe et al., 1998; Shepherd, 1998; Sosniak & Stodolsky, 1993; Strong, 1998; Tsai, 1998).

Positive teaching belief can be enhanced by teachers' education and professional development (Maor, 1999). Environmental education teachers in Canada and Taiwan need effective professional development that emphasizes experiential learning, cognitive as well as affective outcomes, and contextualized problem solving. Teachers empowered by such professional training will be more willing to engage in environmental teaching and positively influence children's learning.

Canadian elementary school teachers appear to utilize experiential and interdisciplinary learning approaches to motivate children's environmental learning. However, these approaches do not appear to promote environmental knowledge and its influence on responsible environmental behavior. Teachers need to decrease rote learning of low-level ideas and increase their emphasis on meaningful learning where conceptual ideas are focused on practical problems and realistic solutions. Meaningful conceptual learning is a time-consuming process, but it appears that approaches stressing affective-based actions rather than informed actions are not achieving the desired outcomes. Environmental education curriculum needs to stress a balanced approach to critical decision making in which emotions, values, beliefs, and attitudes are fused with ecological and environmental understanding to make committed, informed decisions.

Elementary environmental teaching in Taiwan appears to develop environmentally responsible grade 5 children. However, individuals developed under precise teaching schedules and systematic content teaching still need to be provided more meaningful activities for environmental learning. Creating democratic environmental discussions in classroom, student-centered learning, and reflection activities are necessary if environmental education expects to develop an environmentally responsible individual with critical thinking and self-efficacy (Breiting & Mogensen, 1999). The Taiwanese children's lower confidence of action toward the environment can be improved by changing teaching strategies from a teacher-directed to a student-centered approach. An environmental classroom should allow students to establish and clarify their own values and to make their own decisions based on these values (Hungerford et al., 1985). Reflection activities provide opportunities for children to share their thinking and clarify their environmental values (Kyburz-Graber, 1999). Teachers should be aware of the unequal dialogue in the classroom and challenge students' environmental understanding

by problem-oriented questioning. Authentic environmental problems need to serve as the central focus for the experiential learning, and students should be encouraged to propose solutions and provide justifications for their discussions.

Concrete experience with the environment is the crucial element for developing children's positive environmental performances. Nature experiences that result from family, community, and school can provide an authentic context for exploring environmental issues, concepts, and problem solving. Since informal nature activities are not readily available for Taiwanese children, teachers need to create more nature activities (school yard activities, local walking tours, field trips, camps, etc.) within an action-based curriculum to enhance children's connection with nature and to develop a sense of stewardship for their environment (Dresner & Gill, 1994). Action-based learning provides opportunities for children to obtain experience and develop problem-solving skills embedded in the complex context of the environment. These activities develop children's sense of empowerment and responsibility through discovering and investigating their environment. Children will also be able to clarify their values and increase the environmental vocabulary through solving problems and to develop meaningful insights into the complex relationships of causes and effects (Cummins & Snively, 2000).

Environmental educators need to work with children's families and the community to develop responsible environmental citizens (Evans & Gill, 1996). Elementary environmental teachers can be facilitators to improve family communications in Taiwan by encouraging children to do collaborative or home-school projects designed to be completed with their family. The project task should be designed for learners to utilize local community resources in order to strengthen the connection between individuals and their communities. The take-home projects will potentially increase educational interaction between children and their family, communities, and school. Children's confidence will increase when they are provided the opportunities to express their thinking within a familiar, supportive, and encouraging context.

Implications for Future Research

The variance in Canadian and Taiwanese environmental behavior was not substantially explained by the environmental and demographic variables used in this

study. This might be due to external factors that were not considered in this research. Children's REB needs to be further investigated by direct observation and interventions. Future studies need to consider home residential area and children's skills for improving the environment in order to understand the influential predictor relationships to the children's REB.

Canadian and Taiwanese CREB models were proposed in this study. Future studies need to test the stability of these CREB models on environmentally active and non-active children and extend to children of different ages to explore if these models change over a range of ages.

Furthermore, teaching and learning dimensions in the classroom and school environment should be further explored by action research approaches. These studies should include observing how teaching is delivered in the classroom, how the teachers utilize instructional resources, how different environmental activities influence cognitive and affective outcomes, how teachers and students interact with each other in an environmental education classroom, and how the school's environmental policy influences children's environmental behavior.

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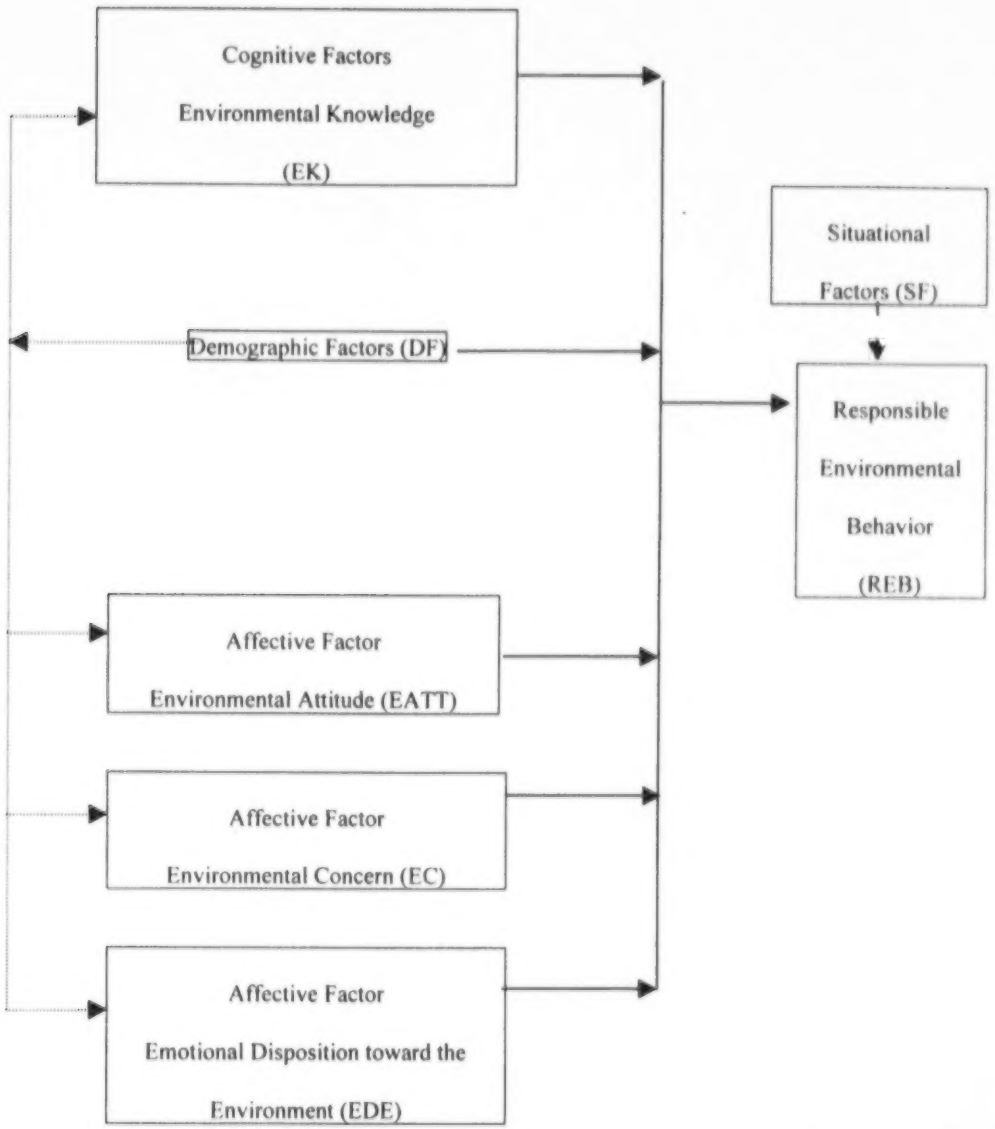

Figure 1. Children's Responsible Environmental Behavior (CREB) Model

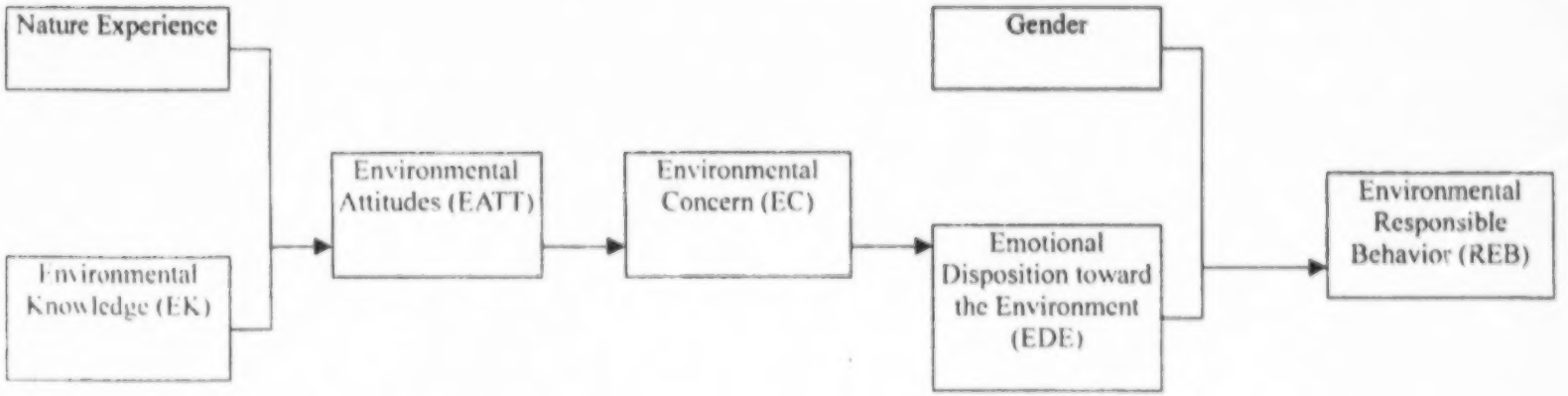

Figure 2. Canadian Children's Responsible Environmental Behavior Model (Canadian CREB Model).

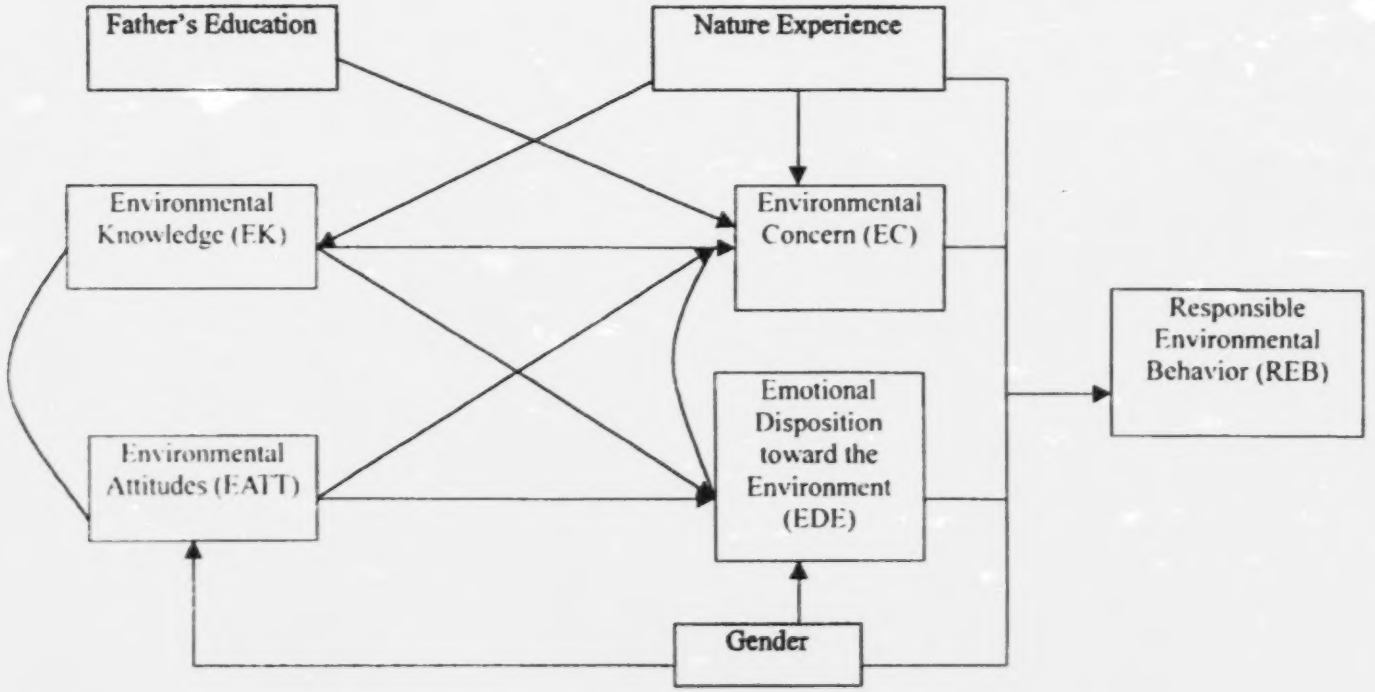

Figure 3. Taiwanese Children's Responsible Environmental Behavior Model (Taiwanese CREB model).

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